

Patent Claims

1. Process for monitoring the free space in the direction of travel of a vehicle,

wherein image data of the vehicle environment in the direction of travel is recorded using a camera system,

wherein, additionally, on the basis of the operating parameters and dimensions of the vehicle, the three dimensional free space required for unimpeded travel of the vehicle is pre-calculated in a signal processing unit, and

wherein the operator of the vehicle has displayed to him at least the part of the detected image data representing the required free space,

thereby characterized,

that the display of the image data occurs essentially as it would appear from the perspective of the operator of the vehicle directly viewing the vehicle environment in the direction of travel,

and that at least the image data associated with the three dimensional free space is subjected to a further processing,

wherein as a result of this further processing the vehicle operator is informed with regard to whether or not sufficient free space is available for unimpeded travel.

2. Process according to Claim 1, thereby characterized, that in the further processing, dynamic changes over time taking place in the image data are taken into consideration.

3. Process according to one of the preceding claims, thereby characterized, that the informing of the vehicle operator in the

case that sufficient free space is not available for unimpeded travel occurs by warning means, in particular optical, acoustic or haptic perceivable signal providers.

4. Process according to one of the preceding claims, thereby characterized, that the informing of the vehicle operator in the case that sufficient free space is no longer available for an unimpeded travel occurs by pictorial display of at least a part of the further processed image data, wherein, in these image data, those objects which are located in an impeding manner in the free space required for the travel are represented enhanced or highlighted above the other image objects.

5. Process according to Claim 4, thereby characterized, that the enhancement occurs in such a manner that the impeding objects have superimposed thereupon symbols, which represent their direction of travel and/or speed of movement.

6. Process according to one of the preceding claims, thereby characterized, that the informing of the vehicle operator with regard to the existence of a sufficient free space occurs by the pictorial display of at least a part of the further processed image data,

wherein the displayed image data has superimposed a symbolic representation of the edge boundaries of the required free space as determined by the pre-calculations in the signal processing unit.

7. Process according to Claim 6, thereby characterized, that the symbolic representation of the edge boundaries occurs by symbolic represented walls.

8. Process according to Claim 6, thereby characterized, that the symbolic display of the edge boundaries occurs by the symbolic representation of walls and a ceiling area and/or floor area, forming a tube or tunnel.

9. Process according to one of Claims 6 through 8, thereby characterized, that the edge boundaries are visualized by the display of a grid, a sequence of columns or a checkerboard pattern.

10. Process according to one of the preceding claims, thereby characterized, that the wall area and/or ceiling area and/or the floor area is so designed that it

- has a geometric distinct and unambiguously recognizable structure,

- permits a "through view" to the video scene lying there-behind, and

- is so calculated, that it appears to be standing still even while the vehicle is moving in the longitudinal direction.

11. Process according to one of the preceding claims, thereby characterized, that the scene displayed to the operator of the vehicle is intermediately stored for at least a specified past time interval or a particular traveled-through vehicle path, and can be called up by the vehicle operator for repeated display.

12. Process according to one of Claims 6 through 11, thereby characterized, that the camera image data having superimposed thereon the edge boundaries of the required free space are supplied to a video processing process based on the optical flow, which compares the movement of the spatially-fixed edge boundaries in the image data with the actual movement of objects in the image,

wherein those objects in the image, for which the model flow is less than the actual measured flow, are evaluated as potential collision objects.

13. Process according to Claim 12, thereby characterized, that in the case of the presence of a potential collision object, this object is optically accentuated or highlighted, for example with color, and/or results in a warning being given to the vehicle operator via a warning signal.

14. Device for monitoring the free space in the direction of travel of a vehicle,

with a camera system for acquiring image data from the vehicle environment in the direction of travel of the vehicle,

with a signal processing unit, which is in communication with sensors for detecting the operating parameters of the vehicle and which includes a memory in which data is recorded regarding the dimensions of the vehicle,

as well as a display unit in communication with the signal processing unit, for display of at least that part of the image data representing the required three-dimensional free space,

thereby characterized,

that the memory associated with the signal processing unit is so designed and arranged, that

a number data sets are recorded in the memory regarding different vehicle dimensions, each of which can be specifically selected and made available to the signal processing unit,

and/or the memory is provided with a means via which the at least one data set stored in memory can be changed out.

15. Device according to Claim 14, thereby characterized, that the means for specific selection of a set of data stored in memory include a keypad operable by the vehicle operator.

16. Device according to one of the preceding claims, thereby characterized, that the means for changing the at least one set of data stored in memory includes a communication device for the wireless transmission of data.

17. Device according to one of the preceding claims, thereby characterized, that the camera system includes at least one catadioptric camera.

18. Device according to one of the preceding claims, thereby characterized, that the device includes a memory for intermediate storage of at least a part of the image data displayed to the operator of the vehicle, and that a means is provided via which the vehicle operator can call up this intermediate stored image data for repeated viewing.

19. Device according to one of the preceding claims, thereby characterized, that the device includes a unit for image

processing on the basis of optical flow, via which the image data having the edge boundaries of the required free space superimposed thereon can be processed to the extent,

that the movement of the positionally fixed edge boundaries in the image can be compared with the actual movement of objects in the image,

so that those locations in the image, at which the model flow is less than the actual measured flow, can be evaluated as potential collision objects.

20. Device according to Claim 19, thereby characterized, that the device includes a unit for image processing that is in communication with a display for the vehicle operator and/or a warning signal generator,

such that the potential collision object can be accentuated in the represented image or the vehicle operator can be warned of these objects.

21. Use of the process and/or device according to one of the preceding claims in monitoring the backing-up in the repositioning operation of vehicles.